

CLAIMS

What is claimed is:

1. A microwave arrangement for de-icing and keeping ice-free hollow body structure surface areas which are subjected to meteorological influences of the atmosphere and which include leading edges that are exposed to air flow and consist of one of fiber compound materials including at least one of carbon fibers, and glass fibers and other fibers with additives providing for some electrical conductivity, and a metallic coating, each of said hollow body structures being microwave-tight, said arrangement including:
at least one power supply connected to an electrical source, at least one microwave source connected to said power supply provided for each hollow body structure, a hollow conductor connected to each microwave source for conducting microwaves to a predetermined area of a wall area of said hollow body structure for heating said wall area, said leading edges being divided into sections arranged adjacent one another and having surface segments of equal areas, said sections being formed between ribs, which extend normal to said leading edge and are firmly connected to said hollow body structure, said hollow body structures disposed side-by-side along the leading edge being sealed from each other in a microwave-tight manner by said ribs and spars, a hollow conductor uncoupling structure being mounted on said spars and extending therethrough for connection to said microwave source, the geometry of said hollow space and the frequency of said microwave generator being so selected that, in each hollow space, upon energization of the respective

microwave source, an electromagnetic field in over-mode state is generated for supplying equal amounts of heat to the walls of said segments of compound material for their excitation, metallic double conductors of an electrically conductive material being disposed along the leading edge and along end areas of said surface segments up to the spar and interconnected with the respective cooling circuit extending along the microwave sources and the leading edge so as to form a closed cooling circuit and providing in one of the double lines extending along the leading edge end the ribs a counter-current flow, said cooling coil being disposed in a series coolant flow arrangement.

2. A microwave arrangement according to claim 1, wherein said uncoupling structures have a round cross-section.

3. A microwave arrangement according to claim 1, wherein said uncoupling structures have a rectangular cross-section in order to provide, in the hollow space in which said uncoupling structure is installed, a multi mode excitation in addition to the base mode.

4. A microwave arrangement according to claim 2, wherein as microwave sources, based on the geometry of the area to be heated, the operating frequency and the power requirements, one of magnetrons, klystroms, backward wave oscillators, extended interaction oscillators, gyrotrons and klystodes are used.

5. A microwave arrangement according to claim 4, wherein the double lines of an area which are integrated into the fiber structure and through which coolant is conducted are, at least in the de-icing areas, metallic tubes of round or polygonal cross-section.

6. A microwave arrangement according to claim 5, wherein the cooling circuit includes at least the double lines and the microwave sources associated therewith for an area to be kept free of ice.

7. A microwave arrangement according to claim 6, wherein each cooling circuit includes a coolant-circulating pump.

8. A method of de-icing and keeping the surfaces of hollow body structures free of ice which structures are exposed to atmospheric influences and which have leading edge areas which consist of fiber compound material, said edge areas consisting of a fiber reinforced material provided at its outer exposed surface with a metallic material coating and each of said hollow body structures being microwave-tight, and wherein each of said hollow body structures includes at least a power supply connected to an electrical energy source, at least one microwave source operable by said power supply, a hollow conductor connected to said at least one microwave source, for conducting microwave energy to a wall area of said hollow body in order to heat said wall area, said wall area being divided into equal surface sections disposed adjacent one another along said leading edge and being defined by ribs extending normally from the leading edge in the hollow body structure in spaced relationship and further by spars extending parallel to said leading edge so as to form microwave-tight chambers, and an uncoupling conductor structure supported in each chamber on said spars in a position parallel to said front edge and being connected to said microwave source, with the geometry of the chamber and the frequency of the microwaves being selected so that in each chamber an electromagnetic field with excess modes is generated when the microwave source is switched on for uniform heating of the equal-size surface segments of fiber reinforced material, metallic double lines of conductive material extending in the

area to be kept ice free along the leading edge and forming, together with cooling coils of said microwave sources, a cooling circuit with the coolant in the double lines flowing in opposite directions and the cooling coils of said microwave sources being arranged in a series circuit, said method comprising the steps of: maintaining the coolant flow through the cooling circuit for a certain area of the equally sized surface segments along the leading edge in order to maintain the structure along the double line free of ice, operating said microwave sources mounted in said hollow spaces such that, within a cycle period, at least one microwave source is operated while the others are shut down such that, between two operative microwave sources, there is another one which is shut down, and operating each microwave source which is in operation selectively continuously or in a pulsed manner for controlling the heat input into the respective surface segment.

9. A method according to claim 8, wherein, at least initially, each of the coolant pumps installed in said cooling circuits is operated for circulating the coolant through the microwave sources and through the cooling circuit for heating and de-icing the surface areas adjacent the cooling circuit.